Final Report

A project under the Canada
New Brunswick Conservation
and Renewable Energy
Demonstration Program

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CORDWOOD PASSIVE SOLAR HOME

TIDE HEAD, N.B.

RICK MC RAE

FEBRUARY, 1985

CREDA PROJECT # 2012

Canada/New Brunswick Conservation and Renewable Energy Demonstration Program

The Conservation and Renewable Energy Demonstration Program Program is administered in New Brunswick by the Energy Secretariat and managed jointly with Energy, Mines and Resources Canada. The Program is designed to help demonstrate promising conservation and renewable energy technologies, to develop public awareness and understanding of these technologies, and to create employment in new or existing industries.

Through over 100 demonstration projects in New Brunswick, a wide variety of conservation and renewable energy technologies have proven to be technically sound and economically attractive. These demonstration projects should now provide a catalyst for commercialization and lead to widespread adoption of many of these proven technologies.

This final report is based on a project which was financially supported by the Energy Demonstration Program. For further information on other demonstration projects funded in New Brunswick under this program, contact:

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Programme Canada/Nouveau-Brunswick de démonstration des économies d'énergie et des énergies renouvelables

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Un grand nombre de projets de démonstration se sont avérés à la fois techniquement réalisables et économiquement attrayants.

Le succès ainsi rencontré encourage la commercialisation des procédés les plus accessibles. Cela entraînerait certes l'adoption d'un grand nombre de ces techniques par les propriétaires de domiciles et par l'industrie privée.

Ce rapport final est basé sur un projet qui a reçu une aide financière du Programme de démonstration. Pour de plus amples renseignements, communiquez avec la:

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D E N I D E R E S P O N S A B I L I T E

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1.0 EXECUTIVE SUMMARY

The Cordwood House was a project designed to demonstrate several technologies appropriate to the construction of single family homes.

The two-storey building uses cordwood (or stackwood) construction to potentially use the landowners own unprocessed timber. A sunspace is attached to the south facing wall of the house to act as a greenhouse and solar collector. Additionally, two commercially available collectors provide domestic hot water.

A rock storage area in the basement serves to capture any heat in excess of the needs of the building. At times when the building requires heat, the rock storage is tapped first before auxilary heat is called upon.

In relation to its design requirements, the house has met the expectations of the owner. Even in the relatively severe winter season, the building uses less energy than similar sized units in the area.

1.0 SOMMAIRE RECOMMANDATION

Le projet de maison solaire en rondins a été conçu en vue de démontrer plusieurs technologies appropriées à la construction de maisons unifamiliales.

Cette maison de deux étages a été construite en rondins (ou bois de corde) dans le but d'utiliser le bois non traité du propriétaire du terrain. Une annexe solaire, située sur la face sud de la maison, joue un double rôle de serre et de capteur solaire. En outre, deux capteurs solaires qu'on peut trouver sur le marché fournissent l'eau chaude domestique.

Une aire de stockage en pierres dans le sous-sol sert à conserver la chaleur excédant les besoins du bâtiment. Lorsqu'un besoin de chaleur se fait sentir, on libère la chaleur stockée avant de faire appel au système de chauffage auxiliaire.

Quant à sa conception, la maison a répondu aux attentes du propriétaire. Même par temps très froid, elle utilise moins d'énergie que les habitations de dimensions comparables dans la région.

2.0 INTRODUCTION AND BACKGROUND

While contemplating the construction of a new house, the project manager decided to explore the possibility of reducing costs. While economy of construction materials was important, the long term benefits of a building designed for low energy consumption and general conservation were of greater concern. After much research, a design was arrived at.

The building was planned by the owner in close cooperation with a group of professional energy conservation designers. Features of the building include poured concrete foundation, cordwood walls, attached greenhouse, solar DHW, rock storage facility and a massive central chimney/heat storage/destratification system.

This project was undertaken as a demonstration project under the Canada/New Brunswick Conservation and Renewable Energy Demonstration Program to emphasize to the public the need for a more practical approach to the building, heating and cooling application in the residential sector of Northern New Brunswick. It is a fact that most people construct homes on sites preferred for their view, often neglecting their energy needs, which may be obtainable, to a great extent, from their surroundings including the sun, the wind and running water. Especially in this geographical area, the general population believes that no viable use can be made of the sun due to an extreme winter climate. This project proves otherwise.

The site of this project is a riverside lot on the Resitigouche River in the Village of Tide Head, 4 miles east of Campbellton, New Brunswick, on Route 134.

The structure encompasses 2,100 square feet of living space, 340 square feet of unheated adjacent structures, and a 2,800 cubic foot attached greenhouse. All three technologies involved in the demonstration program, that of cordwood construction, passive solar heating and active solar water heating, are incorporated into the structure.

The project was initiated to develop an understanding of the alternative methods of residential construction and the application of passive and active solar resources.

The demonstration was to prove that cordwood construction could be undertaken and completed by non-professional labourers at a price less that the cost per square foot of average residential construction in the same area.

It was also to demonstrate that with the application of a passive solar design and hybrid storage system, an estimated saving of at least 50% in heating needs could be accomplished.

As well, the active solar hot water system incorporated for domestic use was to demonstrate an estimated 75% saving in cost of heating water for domestic use in comparison with standard electric or gas-fired systems presently in use in the majority of households.

Due to the escalating costs of home construction by standard methods, the cordwood system was selected as it was estimated that the cost per square foot could be reduced considerably and the owner/builder, who was not an experienced contractor, could actively participate in the majority of construction plans. By the same means, a passive solar system was incorporated into the design to alleviate energy costs. As this design allowed for the construction of an attached greenhouse larger than most, it was also condusive to food production, again a means of alleviating escalating costs.

The domestic active solar hot water system was chosen over standard systems such as electricity or propane as even though the period in which the initial investment would be recouped would be longer, the term costs would be less.

Financial considerations, therefore played major parts in the decisions to proceed with the aforementioned technologies as opposed to the standard means of providing housing and energy.

Initial estimations of cost saving are:

1. Construction of house - 30% less per square foot than by standard means.

2. Passive solar heating - a reduction of heating costs by at least 50%.

3. Hot water heating - costs reduced by 75%.

Through public visitation, a greater awareness of the viability of cordwood constuction and passive solar application would evolve, thus assisting new home owners to reduce construction costs and energy needs. Also through application of solar technology on the installation of a solar hot water heating system, the public would be made aware of this important benefit and savings generated.

3.0 DESCRIPTION OF THE DEMONSTRATION

Cordwood construction is not a new method of construction and has been used for years in different countries where raw materials are readily available to reduce construction cost. The process involves the laying of low density whole wood logs of two feet in length layer upon layer and solidifying each layer by the application of 4 to 5 inches of Mortar to the extreme ends of each layer. (Visualize a neatly stacked woodpile.) The space between the mortar, and surrounding each log, is filled with insulation consisting of wood shavings mixed with lime (used to dehydrate shavings and deter insect infestation).

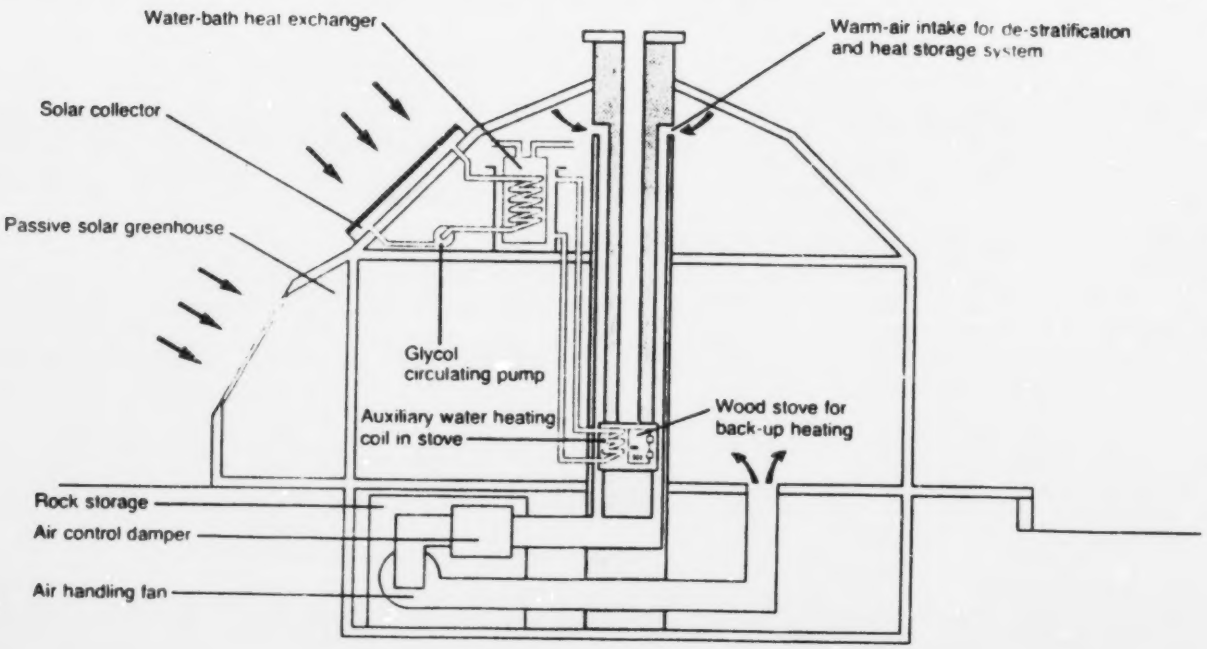
When the desired height is attained, the last layer is leveled with mortar and the roof is affixed. In this particular project, three walls were constructed of cordwood and the south facing wall, of stone to act as the north wall of a 2,800 cubic foot greenhouse. The stone wall, called a trombe wall, allows the warm air accumulated in the greenhouse to be transmitted into the main living area where it in turn rises to the ceiling 23 feet above the main floor level.

At the ceiling level is a warm air intake for de-stratification which leads via ducts to the heat storage system in the basement. This storage area incorporates 15 tons of 3/4" crushed stone which is heated to room temperature or higher by the incoming preheated air. It is then transferred to the living area of the house via ducts and a blower to provide the necessary heat.

The active solar domestic water heating involves 2/21 square foot flate plate collectors affixed at a 60° angle to the south slope of the roof.

A solution of 60% anti-freeze and 40% water is circulated by means of a ¼ h.p. motorized pump adjacent to the interior storage area in a closed loop where the solution returns to the storage area. Here it encircles a 60 gallon glass-lined tank which is immersed in a 200 gallon plastic vat. This vat is also filled with water. Therefore, the returning prewarmed solution serves to heat the 60 gallon tank, the well water it contains and the water in the vat.

The motor is controlled by a solar sensor which activates the pump when the solution temperature is 10° warmer than the water in storage and de-activates same when there is a 3° variance.



4.0 OBSERVATIONS DURING INSTALLATION AND MONITORING

Other than the fact that cordwood walls are constructed with great difficulty during rainy days - of which there were 27 during our construction period - the actual building encountered few difficulties. We overcame this problem by constructing plastic canopies to cover the walls.

As there is no comparison to be made as far as prior heating costs are concerned, this being a new dwelling, I can only indicate that the supplementary heating system, the wood stove, uses approximately 3 cords of wood per heating season to maintain a room temperature of 70° F.

5.0 COST/BENEFIT ANALYSIS

The cordwood solar house project was funded primarily by the proponent, who provided $52,000. The Canada/New Brunswick Agreement pledged $9,900 to the project through the Conservation and Renewable Energy Demonstration Program sponsored by Energy, Mines and Resources Canada and the N.B. Energy Secretariat.

The actual cost of the domestic solar water system was $1,500 of which $300 was labour and the balance was capital expenditures for apparatus.

The actual cost of the passive solar heating system, not including the cost of the greenhouse, was approximately $4,200 of which $3,000 was for apparatus and $1,200 for labour costs.

It is estimated that the domestic hot water requirements for a 3 member family would be approximately $30 per month or $360 per year. The actual cost of domestic hot water for the first operative year is estimated to have been $120 or a 66% saving.

Conventionally heated houses of this size would require approximately 10 cords of wood per year, whereas, during the initial year of operation the project house utilized only 3 cords of wood - a difference of 7 cords or at the market price of cordwood of $70 per cord or $490 - a 70% saving.

The actual building costs per square foot of a conventional house were approximately $45 or $100,000 per the project house. As the cost of construction was less than $50,000, there was an approximate 50% saving in the building cost.

6.0 CONCLUSION

As per the cost/benefit analysis, the overall objective of reducing costs, both initial and energy, have been met. It is hoped that the countless visitors to the site, both during construction and since the project's completion, will use the knowledge obtained to venture further into the world of solar application.

7.0 RECOMMENDATIONS

As the applications per Project #2012 are not new, but simply new to the region in which they were applied, it can only be hoped that those people so influenced by its completion will take advantage of the fact that is has been successful. The use of such equipment should be promoted at government level. As per my conclusion, people have become interested yet require more incentive to actually partake in this phase of energy conservation. Perhaps interest-free government sponsored loans pertaining to this type of energy application would provide that incentive.